

November 1964

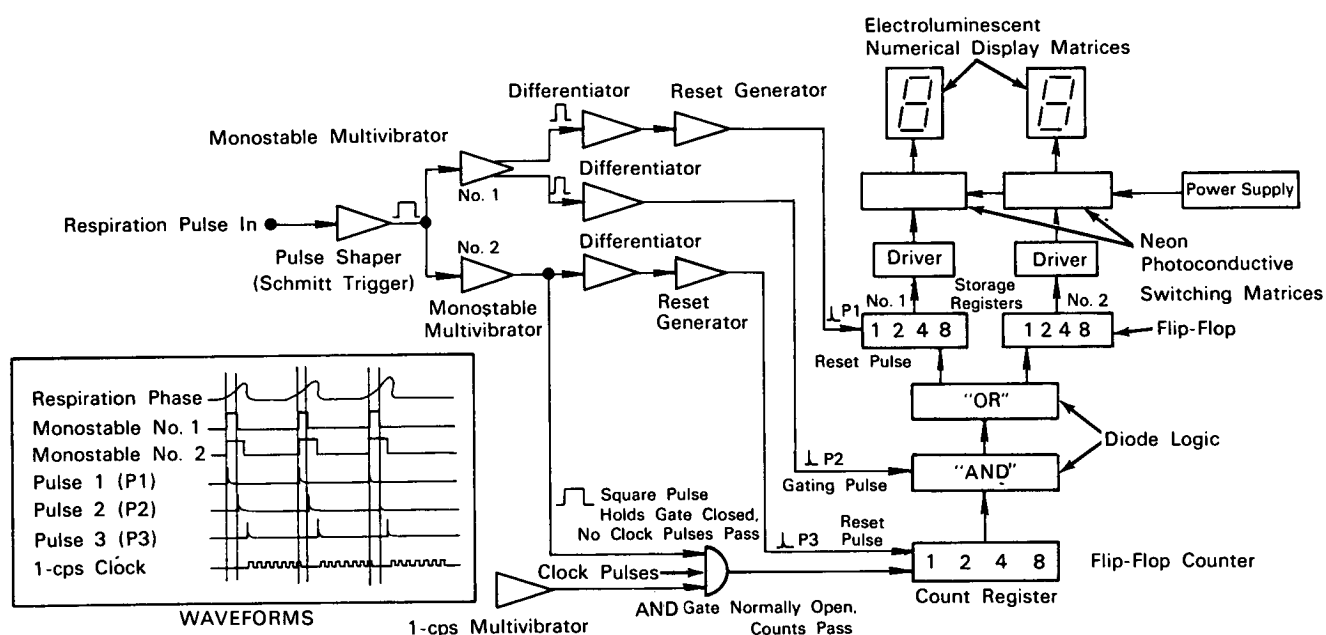
Brief 64-10259

# NASA TECH BRIEF



This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the space program.

## Pneumotachometer Counts Respiration Rate of Human Subject



**The problem:** To monitor respiration rates, in breaths per minute, on a breath-to-breath basis.

**The solution:** Two rate-to-analog converters are alternately used to read and to count respiration pulses from a body sensor (an impedance pneumograph) over fixed intervals of time; the converter outputs are sequentially displayed numerically on electroluminescent matrices.

**How it's done:** The respiration waveform from the body sensor is fed into the pulse shaper (Schmitt trigger), which provides an output that sets the two control monostable multivibrators to the ON condition. The ON time for multivibrator No. 1 is less

than the ON time for multivibrator No. 2. The difference in ON time between the two multivibrators allows the two square-wave outputs to be differentiated to create three sequential timing pulses. Pulse 1 resets storage register No. 1, pulse 2 gates information from the count register into this storage register, and pulse 3 resets the count register. The ON time of multivibrator No. 2 inhibits the dual input AND gate. The 1-cps clock pulses are only allowed into the count register in the time between respiration pulses, which is the OFF time of multivibrator No. 2, and are counted by the count register in this OFF time. During the gating-pulse time, the binary number in the count register, which represents the time in seconds between

(continued overleaf)

breaths, is steered by the AND-OR logic into the storage registers.

The AND-OR logic circuitry essentially divides the count-register binary number (time between breaths) into 60, and the resulting quotient (breaths per minute) is routed to the proper storage register. The AND-OR logic is complicated by the fact that the photoconductive matrices require a 1-2-4-8 binary-coded input to drive the electroluminescent displays; hence, a separate storage register must be used to address each matrix properly.

The AND logic circuitry decodes the four-bit-count register number into one of 15 "hot" lines, and the OR logic circuitry routes the activated line into each storage register as a 1-2-4-8 binary code. The OR logic circuitry sets the binary 6-3-2-1-0 code into storage register No. 1. The OR logic is also capable of setting one of the binaries for 0 through 9 into storage register No. 2. The activated "hot" line determines which binary is set into each storage register. The digital rate meter has the capability of driving the electroluminescent matrices to display numbers 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 30, and 60.

The intervening numbers in this range could be achieved by increasing the clock frequency, increasing the count-register capabilities, and by increasing the complexity of the AND-OR steering logic. The accuracy of the digital meter is a direct function of the clock frequency.

**Notes:**

1. Although primarily developed for space-medicine research, this digital rate meter may have application as a clinical diagnostic aid or as a teaching aid for medical students.
2. Inquiries concerning this innovation may be directed to:

Technology Utilization Officer  
Manned Spacecraft Center  
P.O. Box 1537  
Houston, Texas, 77001  
Reference: B64-10259

**Patent status:** NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Olin Graham  
(MSC-92)